Health, nutrition and growth in infancy – a child health care perspective

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To the love of my life

Geir

"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health"

Hippocrates 460-377 BC.

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ABSTRACT

Early childhood is recognised as a key period for the new family in which to promote health. There is evidence that infant feeding and nutrition is one of the most influential factors affecting growth, development and life-long health. The aim of this thesis was to study infant food and feeding, as well as the impact of different feeding practices in infancy on early growth in childhood and, to explore parental views and considerations relating to child health.

The Halland Health and Growth Study (H^2GS) is a prospective, longitudinal, population-based, birth cohort study of 2666 infants in Halland, in south-western Sweden. A purposive sample of 16 parents was interviewed, after which the interviews were transcribed verbatim and analysed with content analysis.

In the content analysis, six descriptive categories were identified: body and soul; parental behaviour; good enough parenting; interaction; growth; food and feeding issues. The parents perceived food and feeding issues as one of the most worrying aspects and a significant indicator of the concept of child health. With the parental desire to have a happy, contented child there is a risk of developing long-term, unhealthy feeding habits if and when the child is given something to eat in order to attain this state of mind.

Almost a third (26.9%) reported breastfeeding problems, which is associated with early breastfeeding cessation. There was a significant correlation between breastfeeding problems and poor sucking technique and perceived poor weight gain. There was no association between breastfeeding or formula

feeding at four months and a high BMI at 12 or 18 months. At six months, a positive correlation was found between gruel feeding and a high BMI at 12 and 18 months respectively. Many mothers breastfeed at six months (58.3%), but very few (1.6%) adhered to the recommendations of exclusive breastfeeding at six months. It was more common among parents with low education to choose milk cereal drink.

The proportion of mothers not breastfeeding at four months was significantly associated with low neighbourhood purchasing power. After adjusting for maternal age, smoking and parental level of education, the corresponding odds ratio (1.63 (95% CI 1.07-2.56)) was significant and the trend across the strata was still evident. A multi-level analysis estimated that, in neighbourhoods where > 30% of the families had low purchasing power, 20% more mothers than expected, reported no breastfeeding at four months.

Almost a third of the mothers reported breastfeeding problems, which can be prevented, but the timing is crucial. Few mothers were exclusively breastfeeding at six months. The feeding habits the first four months did not have any effect on a high BMI at 12 and 18 months, but milk cereal drink use at six months was a risk factor for a high BMI at the same time points. It was more common among parents with low education to choose milk cereal drink. The parents perceived food and feeding issues as important indicators of child health. These findings, suggest that a lack of responsiveness to parental beliefs and concerns may jeopardise the credibility of healthy infant diet messages. The neighbourhood purchasing power provided a spatial determinant of the number of mother's breastfeeding at four months, which could be relevant when allocating resources for preventive measures.

Keywords: Child health, breastfeeding, growth, household purchasing power, neighbourhoods, paediatric nutrition.

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SAMMANFATTNING PÅ SVENSKA

En förutsättning för att kunna uppnå optimal hälsa samt att tillgodose en normal tillväxt är att goda matvanor etableras tidigt i livet dvs. under fosterlivet och första levnadsåret.

Vi har hittills studerat 2666 barns matvanor och tillväxt under det första levnadsåret samt föräldrarnas uppfattningar om små barns hälsa. I den senare studien framkom det att föräldrarna uppfattade maten och ätandet som en viktig indikator på sina barns hälsa. Utifrån föräldrarnas önskan om att få ett glatt och förnöjt barn finns en risk för utveckling av ohälsosamma matvanor, om barnet får något att äta för att uppnå detta sinnestillstånd. Personalen på BVC behöver medvetandegöras om hur viktig denna dimension är för föräldrar, för att kunna lägga en grund för att familjen får en balanserad hållning till matfrågor, inte minst med tanke på behovet av tidigt förebyggande av övervikt och fetma.

En av fyra mödrar angav amningsproblem under första levnadsmånaden, vilket har visat sig vara starkt associerat med tidig nedläggning av amningen. Detta kan förebyggas med råd och stöd från personalen på barnavårdcentralerna till mödrar under de första veckorna av amningen. Detta stöd måste utformas med tanke på moderns situation.

Anmärkningsvärt var att endast 1.6% av barnen enbart fick modersmjölk vid sex månaders ålder. När vi studerade effekterna av spädbarnens kostvanor på BMI fann vi att amning eller tillägg under de första fyra månaderna inte hade någon effekt på BMI vid 12 eller 18 månaders ålder. Däremot fann vi att vällingkonsumtion vid sex månaders ålder ökade risken för ett högt BMI vid 12 och 18 månaders ålder vilket inte var fallet med konsumtion av gröt eller puré. Att välja välling var vanligare bland föräldrar med låg utbildningsnivå.

I studien jämförde vi också andelen ammande mödrar vid fyra månaders ålder med bostadsområdets genomsnittliga köpkraft enligt SCB och fann att dessa var signifikant korrelerade. I de områden som hade lägst köpkraft hade 20% fler än förväntat slutat amma när barnet var fyra månader gammalt. Detta pekar på ett starkt inflytande av socioekonomiska förhållanden på amningsfrekvens, vilket måste has i åtanke när man planerar och riktar resurser för förebyggande arbete.

LIST OF PUBLICATIONS

This thesis is based on the following studies, referred to in the text by their Roman numerals.

I. **Almquist-Tangen G**, Bergman S, Alm B, Roswall J, Dahlgren J, Nevonen L. Implications for child health services: A Qualitative Study Exploring Parental Views and Considerations Concerning Child Health, BMC Research Notes, submitted.

II. **Almquist-Tangen G**, Bergman S, Dahlgren J, Roswall J, Alm B. Factors associated with discontinuation of breastfeeding before 1 month of age, Acta Paediatrica. 2012;101:55-60.

III. **Almquist-Tangen G**, Dahlgren J, Roswall J, Bergman S, Alm B. Milk cereal drink increases BMI risk at 12 and 18 months, but formula does not, Acta Paediatrica. 2013;102:1174–1179

IV. **Almquist-Tangen G**, Strömberg U, Holmén A, Alm B, Roswall J, Bergman S, Dahlgren J. Influence of neighbourhood purchasing power on breastfeeding at four months of age: a Swedish population-based cohort study, BMC Public Health. 2013;13:1077.

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CONTENT

ABBREVIATIONS

BMI	Body Mass Index
CHC	Child Health Centre
H^2GS	Halland Health and Growth Study
MCD	Milk cereal drink
NBHW	National Board of Health and Welfare
WHA	World Health Assembly
WHO	World Health Organisation

DEFINITIONS IN SHORT

BMI	Body Mass Index (BMI) is a simple weight-for-height index that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m2).
Exclusive breastfeeding	Exclusive breastfeeding means that an infant receives only breast milk from his or her mother or a wet nurse, or expressed breast milk, and no other liquids or solids, not even water, with the exception of oral rehydration solution, drops or syrups consisting of vitamins, minerals supplements or medicines (WHO 2001; WHO 2008).
MCD	MCD or gruel is a liquid food made of flour boiled in water and it can attain different levels of viscosity.

PERSONAL NOTES

The aim of this thesis was to explore parental views and considerations relating to child health, as well as to study infant food and feeding, and the impact of different feeding practices on infant growth.

My professional background is primarily as a paediatric nurse at child health centres and, for the last ten years, as a co-ordinating child health nurse. My research interest is primarily child health, paediatric nutrition and parental beliefs relating to child health.

Child health is a global issue that impacts individual human beings, families, health care and health economy and it should therefore be a prime concern for all societies. Child health, food, feeding and growth are interlinked in a continuous dynamic process. A healthy baby will eat and grow, and a growing baby will eat and be considered healthy by everybody, especially its parents. The decision to confine this thesis to child health, nutrition and growth was easy, because the project would have become unwieldy and cumbersome if I had included the concept of child development. It would encompass aspects such as emotions, psychology and psychiatry, as well as the concept of normality and/or abnormality. However, it would be presumptuous to claim that this is an exhaustive description of child health but I have highlighted some aspects that I believe warrant clarification.

The double-edged ambition to make use of both qualitative and quantitative methods has been a challenge but I have found some interesting phenomena that I would probably have missed if I had been limited to one type of method. Apart from the fact that it has made the research work more roundabout, it has certainly made the journey more appealing and as J.R. Tolkien (1966) so aptly put it, “You step into the road, and if you don’t keep your feet, there is no knowing where you might be swept off to”(Tolkien, J.R.R., pp. 78).

1 INTRODUCTION

The present thesis seeks to study infant food and feeding, as well as the impact of different feeding practices in infancy on early growth during childhood. Moreover, other aims were to explore parental views and considerations relating to child health. The three disciplines, child health, paediatric nutrition and child growth, are multifaceted, challenging in their own rights and dependent on the population under consideration, contributing not only individually but also jointly constituting the very cornerstone of adult health. Despite numerous studies of these issues, there are still many unanswered questions relating to child health, the effect of early food and feeding practices on growth and subsequently on adult health (Preston, 1998; Blackwell, 2001; Pavalko, 2013). Under- or over-nutrition are serious threats to adequate growth, development, health and performance at school or work. Several major diseases have their origin in fetal and infant life (Barker, 1998). Numerous studies have shown the importance of early childhood in supporting future economic growth and providing a higher rate of return than investments made later in life (Guilleoteau, 2009; Heckman, 2012).

1.1 Child health

Health is generally described in terms of mortality and morbidity and, where infants and children are concerned, also making use of concepts and variables such as birth rate, neonatal death rate, growth and breastfeeding (Boas, 1982; Tanner, 1990; Hall, 2003). Within the medical profession child health is often characterised by physical growth and development. Height is, for example an accepted marker of health and nutrition during the childhood years (Tanner, 1990; Blackwell, 2001; Lucas, 2010). Birth weight often serves as an indicator of the overall health of an infant and is used by epidemiologists as an indicator of general quality of life (Boas, 1982). During the first year of life infant weight gain is often regarded as an indicator of health, especially by parents and professionals (Baughcum, 2001; Wright, 2007; Lucas, 2007; Redsell, 2010). Rapid infancy weight gain is often associated with obesity and health problems later in life (Ong, 2006), whereas slow weight gain and underweight correlates with adverse physical and psychological outcomes (Armstrong, 2003). Paediatric nutrition is often referred to as an important determinant of child health and has a strong association with household income and parental education (Darmon, 2008; Lindeboom, 2009). The overall health status of Swedish children is often described as the best in the

world, with low mortality rates, a high percentage of breastfeeding, low accidental injury rates and low childhood caries levels (Hjern, 2012).

As yet, parental views and considerations relating to child health have not been detectable in academia or the medical world, which is both a theoretical and a practical problem, as it stands in the way of a holistic perspective. Parental beliefs and perceptions of infant and child health are often based on knowledge that has been acquired from experience, literature, the web and from relatives and friends (Almquist-Tangen, 2006; Kelly, 2006). Our knowledge or understanding of how social factors, parental views and beliefs affect clinical phenomena such as infant feeding and growth is more than a little uncertain (Beale, 2001; Dubois, 2003). Considering that parents are the "primary gatekeepers" of their child's health (Case, 2002), it is vital to acquire a greater understanding of parental views and considerations relating to their child's health.

1.2 Paediatric nutrition

The subject of infant diet, e.g. breastmilk, artificial milk, porridge, semisolids, solids and different feeding modes, such as bottle-feeding, weaning practices and the effect this may have on child health and growth, has been widely studied by researchers all within their own discipline, each drawing on distinct theoretical and practical traditions. There are not only dissimilar opinions but also ideological differences when it comes to what, how and which dietary factors during the infant period may have a bearing on the child's future health, such as the risk of malnutrition, growth divergences or obesity (Ong, 2002; Parson, 2003; Ember, 2004; Baker, 2004; Reilly, 2005; Gillman, 2008, Koletzko, 2009; Gale, 2012). During the past decades the focus of nutrition research has shifted from meeting nutritional needs and preventing deficiencies to understanding the effects of infant diet and nutrition on a long-term basis e.g. obesity (Ember, 2004; Lucas, 2010).

During the first months, the main food is human milk (fed from the breast or expressed) and/or another woman's breast milk (milk banks or wet nurses), artificial milk and/or complementary foods and juices (Thulier, 2010). The abundance and range of different infant feeding products such as infant milks, infant formulas, follow-on formulas, milk cereal drinks, gruel, juices and porridges has never been as extensive as it is today (Ember, 2004).

1.2.1 Historical aspects of nutrition

What can we learn from the past in order to understand today's parents and the choices they make regarding infant feeding? The ancient Greek medical writers and physicians Soranus of Ephesus, a Roman physician of the second century AD, and Galen in the late first century, were among the first to describe and write about breastfeeding, infant feeding and health. The first time lactation failure is mentioned, is in the Egyptian medical encyclopaedia (c. 1550 BC), The Papyrus Ebers (Wickes, 1953). Soranus of Ephesus was one of the first to advocate breastfeeding until six months and then preferably by the mother, probably as a direct consequence of high infant death rates. However, making use of a wet nurse was common for many reasons, but it was not always approved of. Soranus and, some ten centuries, later Bartholomeus Anglicus, a Franciscan monk (1220-1250 AD), attempted to list the qualities of a wet nurse. During the Renaissance, there was widespread disapproval of making use of wet nurses (Wickes, 1952). The earliest artificial feeding was most probably hand-feeding, which was criticised by Soranus. He advocated diluted wine, breadcrumbs, soups and eggs for infants at the age of six months. The earliest handcrafted vessels used to feed the infants were undoubtedly animal horns with holes. Spouted feeding vessels used as artificial aids in the nursing of infants dating back to 3000 and 2500 BC have been found in the Sudan, (Lacaille 1950). In archaeological excavations in Greece, Cyprus and Italy, ancient clay feeding vessels have been found dating from about 200 BC. These vessels suggest that infants from the poorer classes were often weaned at an early stage during the neonatal period (Lacaille, 1950). What is interesting is that there are no surviving recipes for preparing and cooking baby food. Most probably, these recipes and advice were passed down orally from mother to daughter (Stevens, 2009).

1.2.2 Breastfeeding

Human breast milk is regarded as the best nutrition for infants because it contains the optimal ingredients for healthy growth and development. In overall terms, there are numerous benefits, medical, economical and ecological, for mother, infant and society (Chen, 2002; Jackson, 2006). In May 2001, the World Health Assembly (WHA) passed resolution 54.2, stating that the optimal length of exclusive breastfeeding is six months (WHA 2002) and that it should preferably be continued into the second year of life (WHO, 2001).

Breast milk can be described as a nutritional active fluid containing antimicrobial, anti-inflammatory and immunomodulatory agents (Bachrach, 2003; Labbok, 2004; Chirico, 2008; Hoddinott, 2008; Jeurink, 2013). Taking the immaturity of the infantile immune system into consideration, this protection is of paramount importance (Jackson, 2006). Numerous studies have revealed protective factors against infectious diseases such as otitis media (Abrahams, 2011), gastrointestinal infections (Duijts, 2009), lower respiratory tract infections (Quigley, 2007; Hanson, 2009) and urinary tract infections (Hansen, 2004; Mårild, 2004). Human breast milk contains water, fat, carbohydrates (mainly lactose) and protein (lactoferrin, alpha-lactalbumin, serum albumin and immunoglobulins) (Jensen, 1995). The volume and composition of breast milk change, adapt over time, and along with the infant's needs (Hytten, 1954; Jensen, 1995; Nakamori, 2009, Jeurink, 2013).

Breastfeeding rates are often used as indicators of child health by governments and authorities in order to make comparisons of the health situation for infants and children between regions and countries (Rigby, 2003). There are two different ways to consider and describe breastfeeding rates; initiation, which describes how many mothers started breastfeeding and the duration, which describes how many mothers continued breastfeeding at certain ages, as well as any breastfeeding or exclusive breastfeeding.

Despite the vast scientific evidence supporting the health benefits of breast milk, breastfeeding rates are declining in particular adherence to the recommendation of exclusive breastfeeding. This is observed in both industrialised and developing countries (Thulier, 2010). In comparison with other countries, Swedish breastfeeding rates are high, with initiation rates at the age of one week of 97.2% and with good continuation rates at two months 88.8%, at four months 78.5% and at six months 66.5%. The rate of exclusive breastfeeding at six months is 11.7% (the National Board of Health and Welfare (NBWH) 2009).

Most mothers are fully aware that breastfeeding is the optimal way to feed their infants (Bailey, 2004; Wachs, 2005; Fewtrell, 2011). The scientific literature on factors associated with breastfeeding duration is extensive and sociodemographic, biomedical, psychosocial determinants and health care organisation interact with one another (Thulier, 2009) (Table 1).

Social and sociodemographic	**Biomedical**	**Psychosocial and attitude**	**Health care service factors**
Social and cultural factors (Nelson, 2006; Pak-Gorstein, 2009)	Maternal fatigue (Heinig, 2006)	Maternal attitudes and desires (Lyon,1981; Butte, 2000)	BFHI (Kramer 2001)
Low maternal education (Wachs, 2005)	Maternal obesity (Amir, 2007)	Maternal self-efficacy (Clifford, 2008)	Inconsistent professional support (Lakshman,2009)
Maternal employment (Kurinij 1989; Javanparast, 2011)	Post partum depression (Hendersson, 2003)	Family circumstances (Kramer,2001; Heinig,2006; Synnott,2007; Hoddinott, 2012)	Post-natal support, home visitation (Britton, 2007)
Low parental age and smoking (Schoetzau, 2002; Ekström, 2003; Giglia, 2007)	Infant health status and infant size (Kramer, 2010)		Prelacteal feeding (Ekström,2003; Tender, 2009; Pak-Gorstein, 2009)
Support from spouse, family members, friends (Clifford, 2008)	Infant tempera (de Lauzon-Guillain, 2012) and crying Li,2008;Wasser, 2011)		Conflicting ideologies (Hunter, 2004)
Non-attendance at pre and postnatal classes (Coleman, 2009)	Childbirth experience (Ember, 2004)		Early hospital discharge (Heck, 2003)
	Breastfeeding difficulties (McCleod, 2002)		

Table 1: Factors associated with breastfeeding duration sociodemographic, biomedical, psychosocial determinants and health care organisation.

1.2.2.1 Sociodemographic factors

Social and cultural factors largely determine the norm of breastfeeding behaviour in society (Nelson, 2006; Pak-Gorstein, 2009). Maternal literacy (Gillis, 2009), low maternal education (Wachs, 2005), short or no parental leave (Kurinij 1989; Javanparast, 2011), low parental age and smoking (Schoetzau, 2002; Ekström, 2003; Giglia, 2007) as well as non- attendance at parental classes, are important factors (Coleman, 2009) all having a negative impact on breastfeeding. A literature review of both quantitative and qualitative studies showed that support from fathers, family members and friends has a significant impact on supporting breastfeeding if these individuals are positive about breastfeeding (Clifford, 2008).

1.2.2.2 Biomedical factors (maternal and infantile)

Perceived breastfeeding difficulties e.g. painful nipples (Ahluwia, 2005; Britton, 2007), breastfeeding problems (McCleod, 2002), maternal perceived insufficient milk supply (Ember, 2004), post-partum depression (Hendersson, 2003), maternal obesity (Amir 2007) and maternal fatigue (Heinig, 2006) all have shown a detrimental influence on breastfeeding. Similarly, certain infant health characteristics have also been shown to have an influence on breastfeeding. For example infant health status, infant size (Kramer 2010), infant temperament (de Lauzon-Guillain, 2012), infant dissatisfaction with breastmilk shown by continuous crying (Li, 2008) as well as fussy infants have all been shown to have a negative impact on breastfeeding duration (Wasser, 2011).

1.2.2.3 Psychosocial and attitudinal characteristics

The decision to breastfeed or not, is made fairly early during the pregnancy (Lyon, 1981; Butte, 2000) and most mothers (90%) begin breastfeeding their infant (NBHW, 2011). Maternal attitudes, earlier personal breastfeeding experience and high maternal self-efficacy all have a significant association with breastfeeding (Clifford, 2008). Several studies have described the maternal perception of the unattainable demand to breastfeed and first and foremost the requirement to breastfeed exclusively for six months. Conversely, in order to take family circumstance into account, mothers cease to breastfeed and switch to bottle-feeding and using a pacifier (Kramer, 2001; Heinig, 2006; Synnott, 2007; Hoddinott, 2012). As described earlier, maternal adherence to breastfeeding recommendations is dependent on many factors (Li, 2008).

1.2.2.4 Health care service factors

The Baby Friendly Hospital Initiative (BFHI) (Kramer, 2001), post-natal support and home visitation have all been shown to have a positive effect on

breastfeeding (Britton, 2007), whereas other health-care service factors have been shown to have a somewhat detrimental effect on breastfeeding; they include inconsistent information from health care providers (Lakshman, 2009), conflicting ideologies (Hunter 2004), busy postnatal wards (McInnes, 2008) and the post-partum hospital stay (Heck, 2003). When it comes to short postnatal hospital stays, some studies indicate a positive correlation with breastfeeding (Winterburn, 2000), while others do not (Waldenstrom, 2003). Moreover, pre-lactal feeding or in-hospital formula supplementation, e.g. the practice of giving the infant some fluid "before the milk has come in", also affects the feeding process (Häggkvist, 2010). This hospital practice varies between 26.5% in Nepal (Khanal, 2011) and 78% in the USA and it is most frequently initiated on the mothers' request (87%) due to fatigue, rather than on medical grounds (Ekström, 2003; Tender, 2009; Pak-Gorstein, 2009).

Despite numerous different projects aimed at the promotion, initiation and continuation of breastfeeding, e.g. the BFHI (Kramer, 2001), health education, peer support, home visitation and rooming-in (Kuan, 1999; Britton, 2008), few of these projects have shown much effect over time and seldom have any evaluations been made.

1.2.3 Artificial milk

As far as possible, artificial milk is made to resemble the composition of human milk, in order to meet the infants' nutritional need and provide a safe alternative (Joeckel, 2009). The main difference between human milk and infant formula are not large in nutritional terms. Infant formula has a slightly higher nutrient and micronutrient concentration than that found in human milk. The manufacturing processes for most infant formulas are very similar, most of them making use of cows' milk as a protein source (Hernell, 2011). In accordance to scientific results, several modifications to infant formulas have been made, during the past decade; they include the lowering of the protein content, addition of bovine α-lactalbumin to improve protein quality, addition of long-chain polyunsaturated fatty acids (LCPUFA) and addition of oligosaccharides as prebiotics (Motil, 2000; Koletzko, 2005; Hernell, 2011).

Research findings are inconsistent in terms of the impact of infant formula (Kramer, 2004) and/or feeding mode, i.e. bottle-feeding or cup-feeding (Li, 2010), on infant growth. Formula fed infants have been shown to grow more rapidly and one major explanatory model has been the higher level of protein content in formula compared with human milk. In a randomised clinical trial, higher protein level in infant formula was associated with a weight gain

during the first two years of life but showed no effect on height (Koletzko, 2009).

Conflicting data regarding the impact of liquids' on satiety compared with solids have also been presented (Almiron-Roig, 2003, 2004). There is speculation that parents may feed the infant independent of internal hunger in order to empty the bottle and it may thereby eat larger volumes. Moreover, it is suggested, that the infant's ability to self-regulate its appetite is affected by bottle-feeding (Li, 2010; DiSantis, 2011; Li, 2012). Bottle-feeding, whether with expressed human milk or formula provides explicit information to the parents on the amount of fluid remaining in the bottle which is comforting to many parents.

Although many mothers read the information on the packages, some find it difficult to read and understand (Labiner-Wolfe, 2008). Studies have shown that parents receive very little, if any, information on formula preparation in order to prevent over dosage or on bottle-feeding from health professionals (Lakshman, 2009). The hypothesis that breastfeeding mothers have a higher level of closeness or maternal bonding has yet to be proven (Bowlby, 1958; Britton, 2006; Jansen, 2008; Morales, 2010).

It is a well-known fact that parents who begin with infant formula are more likely to terminate breastfeeding at an earlier stage (Howel, 2013) and begin with semi-solids earlier (Morgan, 2004; Sloan, 2007).

1.2.4 Complementary food

The first and most common supplementary food is infant cereal, i.e. milk cereal drink (MCD)/gruel or porridge (Grummer-Strawn, 2008). This can be made from cow's milk or goat's milk with common grain such as wheat, rice or millet, or finely ground meat (Ember, 2004). The decision to wean early is more frequently influenced by the perceived needs of the baby than by external advice from professionals (Wright, 2004; Wasser, 2011). Hungry large babies are weaned earlier and boys more frequently than girls (Kristiansen, 2010). In this context, weaning refers not only to the introduction of food products other than breast milk but also to the cessation of breastfeeding (Esterik, 2002).

1.3 Growth

Adequate growth is a traditional measurement of overall nutritional status; growth monitoring is a key element in paediatric practice both for screening

purposes and for following up diseases (Hall, 1996; Sachs, 2006; Lucas, 2007). Previously, poor growth and its end result attracted attention and it is only recently that research has focused on early growth pattern changes and their consequences (Rolland-Cachera, 2005).

Infant feeding begins in the uterus (Jellife, 1976) and the infant's growth curve is a continuation of the fetal pattern (Ember, 2004). Low birth weight or length may be a sign of a growth disorder during pregnancy but it can also be a physiological adaptation to intrauterine conditions such as a small mother, inadequate blood supply through the umbilical cord or inadequate placental-function. Most intrauterine growth-retarded children experience rapid catch-up growth during the first year of life (Albertson-Wikland, 1997). Infants that are large or grow quickly run the greatest risk of developing overweight or obesity, which implies that intrauterine factors and infancy influence infant growth and the subsequent risk of obesity (Baird, 2005; Gillman, 2008; Moschonis, 2008; Kramer, 2011).

BMI, calculated as weight/height^2, is often used to categorise overweight and obesity and it has been widely used in the adult population for the past 30 years (Cole, 1995). It is a parameter that is often made use of in epidemiological studies (Sacco, 2013). The strength of using BMI is first and foremost that it is simple, inexpensive, unobtrusive, easily calculated and useful as a simple baseline and as a longitudinal measurement of relative weight (Cole, 2000). However, it does not distinguish body composition, fat and lean masses nor does it distinguish fat from fat-free mass such as muscle and bone (McCarthy, 2006). There are limitations when it comes to using BMI in the child population, mainly because it does not consider child growth. In addition, it is necessary to take account of methodological errors, e.g. making use of self-reported values of weight and height. To summarise, at a workshop organised by the International Obesity Task Force (IOTF), BMI was regarded as a reasonable measurement with which to assess fatness in children and adolescents (Dietz, 1999).

1.3.1 Infant feeding and growth

Infancy is the only postnatal period in which growth is directly and strongly dependent on nutrition in interaction with the hormonal system, which mediates growth (Crespi, 2011). As described earlier, studies have shown that there is a growth pattern difference between breastfed, formula-fed infants and that the body composition changes rapidly and nonlinearly during the first year of life (Baird, 2005). A systematic review and meta-analysis showed an association between formula feeding and changes in body

composition. This study also showed how the mean differences in fat mass, fat-free mass or the percentage of fat mass differed between the two feeding modes and how body composition changed at the different ages when measurements were made during the first year (Gale, 2012).

Some studies have suggested that prolonged and exclusive breastfeeding may actually accelerate weight and length during the first months (Kramer, 2002). Likewise, it has been hypothesised that early rapid weight gain is a predictor of obesity (Yanovski, 2003; Monteiro, 2005; Sacco, 2013). However, other studies show slower weight gain during the first three to four months among breastfed infants (Griffith, 2009). Studies have also reported that breastfed infants tend to be leaner in late infancy (Burke, 2005). Several meta-analyses have shown a small potential effect of breastfeeding on mean BMI and the empirical evidence indicating that breastfeeding has a protective effect against overweight is still too insufficient and inconclusive to enable any valid conclusions to be drawn (Owen, 2005, Young 2012). These seemingly inconsistent results might be secondary to different conditions in the studies. The formula content (caloric, protein) as well as the way it is prepared can vary as well as the human milk properties. Differences between models of feeding, differences in metabolic response (i.e. protein synthesis) can also influence (Koletzko, 2009). It is also important to consider infant temperament and the way parents perceive and respond to a crying, fussing baby and how this may have an effect on feeding and subsequent growth pattern (Kramer, 2001). In analogy of the above, the choice of growth curves is of central importance (Evellen, 2009).

The feeding transition between four and six months is dramatic and may be accompanied by a decline of growth velocity between six and 18 months that can be perceived as stressful by the parents (Michelson, 1990).

1.4 Child health services

In Sweden all families with preschool children are offered child health care free of charge at the child health centres (CHCs) with a coverage rate of 98% (Wallby, 2012). There is a long tradition of preventive work at the CHCs, including advice on breastfeeding, diet and nutrition; both in individual consultations and at the educational groups, parents are offered the chance to participate in (NBHW, 1981). This parental education programme is designed to reach all parents with verbal and/or written information on topics such as infant and child food and feeding, injury prevention, immunisation and maternal depression (NBHW 1981; 1984; 1991;1994). In this role the child health-care nurses have a unique opportunity to support the parents in their

parental roles and in establishing healthy lifestyle habits (Arborelius, 2001). However, in a recent thesis, results indicated that disadvantaged families were not receiving the extra attention from the CHCs that was intended in a consensus document from 1999 on child health services in Sweden (MFR, 1999; NBWH, 2000; Wallby, 2012).

1.5 The neighbourhood context of well-being and health

Socioeconomic status in early childhood has a significant impact on a range of adult outcomes and is regarded as one of the most important health determinant throughout the course of life (Spencer, 2003). Studies have shown an association between socioeconomic status and health that runs over and above education, employment rates and social class (Condliffe, 2008). The terms "socioeconomic status" and "social class" are widely used in health research for diverse health outcomes (Smith, 2004). Several epidemiological studies have shown a correlation between socioeconomic status, breastfeeding duration, nutrition and child health (Philip, 1997; Dubois, 2003; Amir, 2007; Wallby, 2012). Low initiation and continuation breastfeeding rates among low-income families add to the social inequalities with poorer child health as a consequence (Ivers, 2011). The relationship between socio-economic factors and health-related characteristics such as breast-feeding is not entirely understood, as it is difficult to fully capture and comprehensively control for confounding factors, e.g. behaviour. Social behaviour is thought to be contagious (Ball, 2010) and the socio-economic status of the local community which the individual lives in also contributes to the perception of health and ill health and exerts an influence on certain health behaviours e.g. breastfeeding (Lakshman, 2010). To summarize it up, the conditions of health have improved in recent decades for the population as a whole, but the relative social inequalities in health have not diminished.

Recent advances in GIS, spatial epidemiology and statistical methodology present new opportunities to study environmental, social and behavioural factors underlying geographical variations in disease, ill-health and health rates on a small-area scale. Spatial epidemiology is the description and analysis of geographically indexed health data with respect to demographic, environmental, behavioural, socio-economic, genetic and infectious risk factors (Elliot, 2004).

2 AIMS

2.1 General aims

The aim of this thesis was to study infant food and feeding, as well as the impact of different feeding practices in infancy on early growth during childhood. A further aim was to explore parental views and considerations relating to child health.

2.2 Specific aims

Study 1 – To explore parental views and considerations relating to child health

Study 2 – To study risk factors for discontinuing breastfeeding before the age of one month

Study 3 – To study nutrition patterns at four and six months and their correlation to growth measurements at 12 and 18 months of age

Study 4 – To study breastfeeding cessation before four months of age in relation to household disposable economy

2.3 Hypotheses

Parental views and considerations relating to the concept of child health have both short and a long-term impact on the future health and care of the child.

The cessation of breastfeeding depends on factors that can be modified by the child health services.

Nutritional patterns during the first year of life increase the risk of obesity later in life.

3 MATERIAL AND METHODS

3.1 Study design and participants

The Halland Health and Growth Study (H^2GS) is a prospective, longitudinal, population–based, birth cohort study that recruited children born in Halland, in south-western Sweden, between 1 October 2007 and 31 December 2008. The families in Studies II, III, IV were recruited on their first visit to the CHC, usually when their children were between one and two weeks of age.

The parents in Study I were recruited from three CHCs in south-western Sweden when the infants were between eight and ten months of age and sixteen parents chose to participate.

A questionnaire was developed, it contained questions about sociodemographic factors e.g. parental education and parental smoking, maternal height, pre-pregnancy weight and weight at the time of delivery, paternal weight and height and infant feeding patterns was developed. It was tested and validated on a group of parents of 80 preschool children. A group consisting of statistician, paediatricians and child health nurses then reviewed the questionnaire in order to refine the wording and eliminate ambiguous phrases prior to use with the parents.

Trained child health nurses carried out all the anthropometric measurements at the CHC. Digital scales with the infant naked and using calibrated stadiometers were used. The BMI of the parents was calculated from self-reported height and weight. In this study growth stands for physical growth, expressed as either increase as increase in body weight, body length or both.

The parents in Studies II, III, IV were asked to complete the questionnaire at all the follow-up appointments at the CHC, when their children were one, four, six, twelve,18, 24, 36, 48 and 60 months of age. The present study used information up to 18 months.

All the questionnaires were scanned and converted to SPSS files.

In all, there were 3, 860 births in Halland during the recruitment period. Of these, 2 666 families chose to participate, which gave a response rate of 69.2 %. Three hundred and seventy-six parents actively chose not to participate (9.7%) and 814 did not respond (21.1%). At four months, the response rate

was 2, 544 (65.9%), at six months 2, 479 (64.2%), at twelve months 2, 404 (62.2%) and at eighteen months 2, 241 (58.1%).

To ensure that the participants were representative of the total population, national as well as regional, material for comparison in Paper II was obtained from Statistics Sweden (SCB, 2007).

3.2 Feeding patterns

In this study, the inclusion criteria for breastfeeding have been met by abiding strictly by the WHO recommendations for exclusive breastfeeding. The infants were classified as exclusively breastfed at one, four and six months if the cross-sectional feeding information obtained at one week, and one, four and six months indicated that no liquid or solids foods other than breast milk were being administered to the infants. In this thesis, the breastfeeding definition has been adhered to very strictly.

The infant formulas used by parents in Sweden are standard, commercial cow's milk-based products with a protein content of 13 g/l (52Kcal/l) approximately the same as breastmilk. The MCD or gruel used by parents in Study III is also a standard, commercial flour-based product with a higher protein content 18g/l (72Kcal/l).

3.3 Outcome variables

The main outcome variable in Study II was the discontinuation of breastfeeding before one month of age. In Study III, it was BMI above one standard deviation of the study population for infants at 12 and 18 months. In Study IV, the outcome was non-breastfeeding at four months of age.

3.4 Statistical analysis and data processing

In Study I qualitative content analysis was used. This is a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns and thereby allowing tacit knowledge to emerge (Hsieh, 2005). Content analysis was developed as a method for analysing a body of text; this qualitative technique involves procedures designed to describe views, meanings, intentions and context, thereby yielding valid deductions from the text (Hsieh, 2005; Kvale, 2007; Elo, 2008). This method pays attention to unique themes that illustrate the range of the meanings of the phenomenon rather

than the statistical significance of the occurrence of particular texts or concepts.

For the analysis of the data in the quantitative Studies (II, III) the Statistical Package for the Social Sciences SPSS for Windows, Versions 18.0 (SPSS Inc, IL). In Study (IV) IBM SPSS 20.0.2 and StatXact 6.2.0 (Cytel Inc., Cambridge, MA, USA) were used for the conventional statistical analyses. The multi-level analysis was performed using the Rapid Inquiry Facility free software (Beale, 2008).

In Studies II and III univariate statistical analysis with 2x2 tables and the χ^2-test were used and risks were estimated using the Mantel-Haenzel common odds ratio estimate. In the multivariate analysis, binary logistic regression was used and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. In the light of the size of the study all calculations could be made with good statistical power.

In Study II, the attributable fraction, AF, for breast-feeding problems was calculated using the formula: AF = (the proportion of cases exposed to the factor) * (OR-1)/OR (Coughlin, 1994).

In Study IV we explored the association between breastfeeding at four months of age and neighbourhood purchasing power, taking account of individual-level variables (maternal age, smoking and parental level of education). Each mother was geo-coded with respect to her residential parish (there are 61 parishes in the region) and then stratified by parish-level household purchasing power. It emerged that four neighbourhood characteristics were reasonable to use, *viz*. <10%, 10-19%, 20-29% and $\geq$ 30% of the resident families with low purchasing power.

3.5 Ethical considerations

The four ethical guidelines for research in the Nordic countries require consent, disclosure requirements, confidentiality requirements and requirements for the participant's safety. Study IV required an interview, which may cause more intense emotional stress for informants compared with answering postal questionnaires (Usher, 1997). The rights of the participants were safeguarded through written informed consent and confidentiality. The ethical conflict may lie in the fact that personal integrity is threatened. These risks were minimised by giving detailed information about voluntary participation and the fact that the participants could discontinue participation as they chose. In the delineation of the study, we

tried to minimise the number of questions and to use all questions in the analysis. Not asking questions that may or may not be used in the analysis is an important aspect to consider in research.

The studies, Study I (study number 10/2008) and Studies II, III, IV (study number 299/2007) was approved by the Regional Ethical Review Board in Lund.

3.6 Methodological considerations

The strengths of prospective cohort studies are that they enable the establishment of a sequence of events, can assess several outcomes, control subject selection and control the measurement of variables and end-points (Ho, 2008). However, one aspect that needs to be acknowledged is the influence of confounders, which must be regarded as a possible threat to validity. To avoid this, statistical methods such as multivariate regression are typically employed to "control" for the influence of potentially confounding variables (McNamee, 2005; Pourhoseingholi, 2012). Yet another aspect to consider is that the views of the most socially disadvantaged families may not be represented, as they are least likely to take part in research. Lastly, there is always a risk, that the subjects may improve family diet or health issues, thereby prompting a behaviour change or modifying some of their answers in response to the fact that they know that they are being studied, the so-called Hawthorne effect (Ford, 2008; Jacobsen, 2010).

3.7 Strengths and limitations

The strengths of this study are the number of children participating, the relatively high response rate and the large number of questionnaires. The risk of recall bias is minimised, as all the questionnaires were answered at approximately the correct age of the infant (Tate, 2005; Adair, 2009). Although the response rate is what can be expected in a questionnaire-based study, there is always reason to be concerned about dropouts (Galea, 2007).

3.8 Qualitative research design (Study I)

Both parents were invited to participate but only one father chose to take part in the study. All the parents gave rich descriptions of the concept of child health. Qualitative studies generate narrative stories, explanations, typologies of phenomena and conceptual framework. They can also generate theories and identify relevant variables to be studied subsequently in quantitative

studies, or they can be used in a complementary fashion to yield findings that are broader in scope and richer in meaning (Ho, 2008)

Trustworthiness in a qualitative study should be based on four criteria: credibility, dependability, confirmability and transferability (Shenton, 2004). In addressing credibility, the investigator attempted to demonstrate the parental views and considerations of child health. This was strengthened by the fact that the first author is a qualified child health nurse, carried out all the interviews, read through all the written text and carried out the analysis. Dependability was achieved by the interviews being carried out over a short period of time, thereby minimising the risk of inconsistencies during the data-collection and analysis process. Confirmability was demonstrated by the systematic treatment of data; repeated reading, identification of, and reflection on the content. To allow transferability, this was facilitated through a clear, distinct description of the participants, data collection and the analysis process. Moreover, two researchers were involved in different steps in the analysis to reduce the risk of bias and to justify findings from more than one perspective. To check the validity the two authors separately carried out the steps in the process of analysis. The differences were discussed and revised, after which the two authors formulated a theme together reflecting the latent content.

4 RESULTS

4.1 Study I

Two main themes emerged during data analysis; *Parental inner subjective emotions and experiences* and *External specific influences and measures*. The parents perceived food and feeding issues as one of the most worrying aspects and as significant indicators of child health. With the parental desire to have, a happy, contented child there is an element of risk of developing long-term, unhealthy feeding habits if, and when the child is given something to eat in order to comfort the child.

4.2 Study II

At one week, most mothers (74%) were exclusively breastfeeding their infants, some mixed breast and formula (24%) and very few (1.5%) chose to bottle-feed their infant with infant formula only from the start. When it comes to the number of breastfeeding meals, almost 20% stated that they were breastfeeding more than 10 times a day. The mothers who breastfed fewer than ≤5 times a day were the ones who perceived more breastfeeding problems.

Almost a third of the mothers (26.9%) reported breastfeeding problems, which were associated with an early breastfeeding cessation. In a multivariate analysis, the risk of unsuccessful breastfeeding at one month was increased by the use of a pacifier (OR 3.72 CI 2.09-6.63), maternal smoking (2.09, 1.08-4.05), paternal smoking (1.80, 1.04-3.11), breastfeeding support group (2.49, 1.57-3.94) and breastfeeding problems (2.54, 1.73-3.71).

Poor sucking technique (2.96, 2.14-4.07), support from the maternity ward (2.56, 2.05-3.19), support from the breastfeeding group (2.38, 1.78-3.19) and perceived poor weight gain (1.37, 1.00-1.86) increased the risk of breastfeeding problems.

When comparing the material with the general population we found that the prevalence of gestational age, birth weight, gender and maternal smoking did not differ but we found a slightly lower prevalence of paternal smoking.

4.3 Study III

Most of the six-month-old infants had begun eating solids (91.8%), porridge (87.7%) or gruel (46.6%). In addition, a little more than half the mothers were breastfeeding at six months (58.3%), but very few (1.6%) adhered to the infant breastfeeding recommendations, *i.e.* exclusive breastfeeding at six months. More than half of the infants (59.8%) were drinking 1-2 bottles of 250 ml gruel a day, and some infants (14%) were drinking 5-6 bottles a day.

There was no association between dietary patterns (breastfeeding, formula feeding or mixed feeding) at four months of age and a high BMI at 12 or 18 months. These findings remained after adjusting for parental obesity, parental education, maternal smoking, age and gender of infant, birthweight, gestational age and BMI at four weeks and four months.

At six months, gruel feeding increased the risk of a high BMI at both 12 (1.58, 1.12-2.22) and 18 months (1.53, 1.07-2.17). The significance remained after adjusting for parental obesity, parental education, maternal smoking, age and gender of infant, birthweight, gestational age, BMI at four weeks, BMI at four months and BMI at six months.

Risk factors for bottle-feeding with gruel at six months were; maternal education <12 years (1.89, 1.49-2.40), paternal education <12 years (1.35, 1.06-1.71) and maternal obesity (1.30, 1.04-1.63). There was a negative correlation with infants with troubled sleep and parental group participation. The choice of gruel feeding is influenced by parental factors, especially educational level. A negative correlation with infants with troubled sleep (0.65, 0.49-0.87) and parental group participation (0.79, 0.64-0.98) was also found.

We found no significant interaction between MCD consumption and gender, breastfeeding, or the consumption of porridge and semisolids.

Furthermore, there was no interaction between BMI at one and four months and MCD consumption, but a significant interaction between BMI at six months and MCD consumption was found. Infants with a low BMI at six months had a higher risk of a high BMI and infants with a high BMI at six months had a lower risk of a high BMI at both twelve and eighteen months.

4.4 Study IV

The proportion of mothers not breastfeeding at four months of age showed a highly significant trend across the neighbourhood strata (p for trend = 0.00004): from 16.3% (< 10% with low purchasing power) to 29.4% (≥ 30% with low purchasing power), yielding an OR of 2.24 (95% confidence interval: 1.45-3.16). After adjusting for the individual-level variables (maternal age, smoking and parental level of education), the corresponding (OR 1.63, 1.07-2.56) was significant and the trend across the strata was still evident (p=0.05). A multi-level analysis estimated that, in the neighbourhoods where ≥ 30% of the families had low purchasing power, 20% more mothers than expected, taking account of the individual-level factors, reported no breastfeeding at four months of age.

5 DISCUSSION

5.1 Child health

On a superficial level the parental views and considerations relating to child health corresponded fairly well with the WHO's global definition of health which states "*Health is a state of complete physical, mental and social well-being and not merely the absence of disease"* (WHO, 1948). This definition takes the person's (the adults) own perception of health into consideration and not medical diagnosis. However, the parents brought a much deeper perspective to the concept of child health; they brought the aspect of *care* into consideration, as well as *interaction* and the *parental perception of sixth sense*.

The parents perceived food and feeding issues as indicators of health (Study I). A healthy appetite has often been perceived and regarded as an "indicator of health" (Bentley, 1991;1995). Even though paediatric nutrition is considered to be a very important issue, food and feeding habits have often been regarded as banal practices of everyday life (Lupton, 1996). In accordance with other studies (Bramhagen, 2005) parent's perceived food and feeding issues as stressful (Study I) and is one of the most common parental question (Baggens, 2001).

The parents (Study I) regarded a satisfied, contented child as a healthy child, and for many mothers the infant feeding goal is a contented, thriving baby (Launer, 1989; Hoddinott, 2000). There are many socio-psychological benefits to the feeding situation *e.g.* a smiling infant (Strathearn, 2008; Mohebbi, 2008) will confirm the parent as a "good enough parent" (Bramhagen, 2005; Marshall, 2007). In contrast, divergent feeding patterns and infant dissatisfaction were monitored and perceived as a threat (Study I). A discontented child could be due to many different reasons, *e.g.* hunger, dissatisfaction or pain (Zeifman, 2001). Similarly, some mothers regarded and interpreted infant crying and waking up as indicators of breastfeeding dissatisfaction (Gatti, 2008; Kramer, 2001). Parental interpretation and responsiveness to infant's cues and signals is a critical aspect of quality of care (Alvarez, 2004; Lauzon-Guilleau, 2012). The level of provision of caring behaviour i.e. breastfeeding, health-seeking behaviour and the level of care-giving interaction, is strongly associated with maternal education (Engle, 1997). The parental desire for a contented child and their perception that infant size and growth is an indicator of child health, regarding large

infants as healthy infants, can lead to erroneous decisions regarding food and feeding behaviour (Redsell, 2010).

The parents described food, eating and the feeding situation as consisting of so much more than just the aspect of nutrition (Study I). They were also perceived as a moment to share a cosy time with the infant (van Esterik, 2002). This is an important aspect to acknowledge some parents like to treat themselves and their child to a pleasant moment, for example, and this may include snacks. The question that remains is as follows; does a pleasant moment always have to include food and/or high-energy snacks? This is an aspect that has so far been the subject of little research.

5.2 Paediatric nutrition

Many infants were exclusively breastfed at one week. Very few infants were exclusively formula fed at one week (Study II). At six months many were breastfeeding which agrees with domestic (Alm, 2008) and international scientific studies (Brekke, 2005) but, in comparison with the official Swedish statistics ours are lower (NBHW, 2008), and a long way from the WHO breastfeeding goals (100%). The main difference however, lies in the exclusive breastfeeding rates at six months, where the official rate is 11.8% (NBWH 2008) compared with ours 1.6% which agrees with other scientific studies 1% and less (Howell, 2010; Kelly, 2005; Scott, 2006; Engebretsen, 2007). To summarise, few mothers manage to achieve the WHO goal for breastfeeding i.e. exclusive breastfeeding at six months (Scott, 2006).

One explanation could be the way these data are assembled. In our study (II, III, IV) the parents filled in a questionnaire, with no probing follow-up questions as to why they had begun bottle-feeding. Whereas the official breastfeeding statistics are gathered by the CHC nurses who ask each individual parent if the child is breastfed (NBHW, 2008). Some mothers may feel uncomfortable answering about breastfeeding and possible follow-up questions, which are subsequently noted in the child's health chart, and as a result, they may not always be truthful in their answers (Hoddinott, 2000). It is important to consider the question of just how reliable the breastfeeding statistics are, especially regarding exclusive breastfeeding rates (Aarts, 2000; Ip 2000).

5.2.1 Reliability and accuracy of breastfeeding data

Some major methodological issues have been raised on the quality of some studies presenting breastfeeding rates, such as the size of the study population, the absence of not distinguishing between "any" or "exclusive" breastfeeding and the quality of data set. Several studies are underpowered, have inadequate adjustment for confounders and the lack of a defined causal relationship between breastfeeding and the specific outcome (Aarts, 2000; Peat, 2004; Renfrew, 2007; Hector, 2011; Hoddinott, 2012; Gale, 2012). As described earlier, what and how an infant is fed is relevant for clinicians when assessing infant growth and development. Researchers, epidemiologist and statisticians need breastfeeding statistics that accurately describe and enable comparisons in order to draw any conclusions regarding breastfeeding and outcomes. Robust data are important for policymakers and clinicians when interpreting and making use of breastfeeding rates in order to establish infant feeding trends and to decide future policies. To sum up, the low quality of comparable, robust data and the lack of uniformity and stringency in the collection of breastfeeding data worldwide can lead to confusion when interpreting research and programme experience.

5.2.2 Breastfeeding at four and six months

A correlation between the use of a pacifier and early discontinuation of breastfeeding was found (Study II), which is consistent with other studies (Nelson, 2005). However, it is possible that this is a case of reverse causality *i.e.* the pacifier and the bottle should actually be regarded as a completely adequate way for the parents to try to settle their infant in their desire to have a contented child when breastfeeding fails (Jenick, 2009; O'Connor, 2009; Jafaar, 2011).

Many mothers (26.9%) perceived breastfeeding difficulties (Study II) which were in turn associated with premature breastfeeding cessation (Lewallen, 2006). Approximately one third (30.6%) of the mothers that ceased to breastfeed at one month post partum could be statically be attributed to breastfeeding problems Breast-feeding difficulties were correlated with perceived poor weight gain and poor sucking technique (Study II). Perceived breast-milk insufficiency and low infant weight gain, infant crying and fussing are the strongest indicators of breastfeeding cessation (Piwoz, 1994; Lauzan-Guillian, 2012).

These aspects should be the foremost to be targeted. Most breastfeeding problems are preventable, but to minimize premature breastfeeding cessation, the timing is essential at an early stage before the mother give up breastfeeding. Therefore, intervention, such as breastfeeding observation and subsequent counselling must be early initiated, preferable within the first four weeks.

It is uncertain whether parents are aware that milk production is a supply-and- demand phenomenon, which means that, the more an infant suckles, the more milk is produced. So, the real risk factor when it comes to early breastfeeding cessation may actually be breastfeeding difficulties, which is what our efforts should be concentrated. The health staff need to be made aware of the early signs of maternal discomfort and the parental desire for a contented infant, which may lead the mother to cease breastfeeding altogether.

As described earlier some organisational aspects may have an impact on breastfeeding initiation and duration. Contrary to some studies (Waldenstrom, 2003) but similar others (Winterburn, 2000) we did not find any association between breastfeeding at one month and short postnatal hospital stay (< 24 hrs).

Most of the mothers stated that they had received help, 68.0% and almost all, (96.9%) were satisfied with the help and support they received. Almost a third (26.9%) described having breastfeeding problems and quite a few were not breastfeeding exclusively if at all (Study II). We hypothesize that they did receive help and support but with an off target agenda and the wrong timing. The sooner the new mother learns the technical skills of breastfeeding and thereby prevents breastfeeding problems, the more the emotional challenge of breastfeeding diminishes.

If account is taken of the fact that barely 2% of infants were exclusively breastfed at six months (Study III), which means that almost 98% of the infants were being fed something else, it is time for the health-care organization and the authorities to review not only the information given to the parents but also the baby food products. In comparison with breastfeeding mothers, bottle-feeding parents receive very little, if any, support or advice where alternative infant feeding is concerned (Lakshman, 2009). The parents who decide to bottle-feed their infant have to be self-sufficient and are left to their own devices, which puts these infants at risk of bacterial infections, diarrhoea, hypernatraemia or hyponatraemia, under- nutrition and possible future hospital admissions (Labiner-Wolfe, 2008; Renfrew, 2008). Health-

care professionals often refer to the WHO recommendations and the Innocenti Declaration to explain why they do not give bottle-feeding parents any support or infant formula information (Bailey, 2004; Lagan 2013). However, it is important to explain to the parents that the aim when bottle-feeding the infant is to mimic breastfeeding, in a caring and nurturing way. Considering the importance of early feeding routines, it is essential that parents are offered adequate, caring support, regardless of feeding method (WHO, 2005; Lakshman, 2009, 2010; ICN, 2009; Swedish Society of Nursing, 2007; 2010).

It would appear that the mother's opinion of optimal breastfeeding duration, *i.e.* exclusive breastfeeding until six months of age (WHO, 2001), at least in Sweden, may not match the WHO recommendations. Even though lactation as such is universal, the act of breastfeeding is a personal, maternal choice and should therefore be respected (WHO, 2001). However, the key message should be that breastfeeding for more than six months is ideal and any breastfeeding should be regarded as good enough (Agostini, 2009).

5.2.3 Infant diet at four and six months

Most mothers were breastfeeding their infants, some were mixing the feeds and only a few choose to formula-feed their infant from the start. It is uncommon for parents to choose to formula-feed their infant exclusively at birth (Study II).

Switching to formula and between the different kinds of formula during infancy is usual and is often done without consulting health professionals (Nevo, 2007). Many parents regard formula feeding during the first four months as a "back-up plan" or a solution to a problem, *e.g.* infant crying (DaMota, 2012). Food and feeding have been described as "the oldest and most widely used tranquilizer" (Brobeck, 1960) and it is not uncommon for parents to give their child a bottle in order to settle him/her (Heinig, 2006).

At six months, many infants (46.6%) were drinking MCD. In Sweden, bottle-feeding with MCD, or gruel, is a common feeding practice (Study III). Porridge and MCD are fairly similar products, where the main ingredients are flour and milk (Abrahamson, 1977), enriched with minerals, vitamins and a higher level of protein compared with infant formula. However, we speculate that the infants are able to consume larger volumes of MCD than porridge because satiety may be reached more rapidly with spoon-feeding than with bottle-feeding. This would be consistent with studies showing that bottle-fed infants gain weight more rapidly. We hypothesise that some parents may

regard a bottle of MCD as something to "top up" with and not as a meal, which is a cause of concern. An important aspect to consider is whether MCD as a fluid has a different impact on weight gain and rapid changes in insulin levels than porridge because of the difference in the insulinaemic index (Nilsson, 2005). Many infants were drinking several bottles a day. However, we speculate that the main problem is probably due to the fact that the solid intake is not displaced by gruel, instead the intake of energy-dense beverages increases total energy intake (Mourao, 2007).

The feeding transitions at four and six months have been described as dramatic. The majority of the parents were combining breastfeeding and eating solids (57.9%) and/or porridge (87.7%). During the period of recruitment (2007-2008), the dietary feeding recommendations for infants from the Swedish National Food Agency were exclusive breastfeeding, and when weaning, starting slow with one product at a time, *e.g.* carrot purée for a week and then corn purée for an additional week.

At six months, 12.2% were being bottle-fed with MCD at night. It might appear paradoxical that troublesome sleep correlated with a low intake of MCD. However, we speculate about whether it is possible that infants who are breastfed at night might be perceived as less content but, when they are supported with MCD, they sleep better, which is in accordance with other studies (Lauzon-Guilleame, 2012). These early feeding patterns may imprint a preference for energy-dense foods and diminish the ability to self-regulate intake (Bonuck, 2010). Considering that inappropriate bottle-use is a potential early risk factor for obesity (Bonuck, 2010) and caries (Mohebbi, 2008), this nightly routine with bottle feeding and MCD is an issue which should be discussed with parents. It is apparent that we need to acquire a greater understanding of the way parents from different socioeconomic levels prepare and administer infant formula.

5.3 Infant growth

As described earlier, some studies have shown that formula-fed infants grow more rapidly compared with infants who are breastfed and especially exclusively breast-fed infants (Hediger, 2000; Koletzko, 2009; Kramer, 2004, 2011). In this study (III), no association was found between the nutritional patterns at four months of age and a high BMI at 12 or 18 months. This could be due to that we made use of BMI cut-offs and not trajectories of weight changes. It could also be due to the reduction in the protein content of the infant formula the past decade (Räihä, 2002; Koletzko, 2009).

There has been some speculation that infants that grow more slowly are "satisfied" with their own mother's breast-milk production (Kramer, 2010). As a result, they do not show signs of hunger (crying, fussing, poor sleeping) and therefore continue breastfeeding and are not supplemented with infant formula. The metabolic costs of crying are 20 times those of sleep during the first months (Thureen, 1998) and at 12 weeks, irritability is a significant determinant of the total daily energy expenditure (Wells, 2003). It has been shown that low-income mothers perceived infant crying as a sign of hunger and thus responded with the early use of infant cereal (Baughcum, 2001; Alvarez, 2004; Wasser, 2011). Rapid weight gain has been shown to be significantly associated with infant temperament, with high scores referring to irritable behaviour and this behaviour elicits certain strategies of care in the mother, *i.e.* giving food which influences energy balance, which leads to additional feeding (Wells, 2003; Wright, 2004; Darlington, 2006). The perception of breast milk insufficiency is often based on infant crying (Engle, 1996). Infant crying and fussing peaks at approximately five to six weeks of age and it lessens by the time the infant is twelve weeks old (Lauzon-Guillain, 2012). Unfortunately, the crying rates are often the highest when infant growth rates are at their maximum (Wells, 2003; Alvarez, 2004) and post-natal infant growth is orchestrated physiologically by the INS and IGF pathway but behaviourally by crying and suckling (Crespi, 2011).

At six months, a significant association was found between bottle-feeding with MCD and a high BMI at both 12 and 18 months. However, there was no association with porridge or semi-solids or, most importantly, there was no association with breastfeeding. When analysing the effects of nutritional patterns on overweight, there is a risk of reverse causation, *i.e.* earlier growth patterns, in this case growth from birth to six months, influence both feeding at six months and a high BMI at 12 and 18 months (Kramer, 2010). However, when adjusting for birth weight and weight at one, four and six months, the risk of MCD remained at 12 and 18 months. The association between parental obesity and bottle-feeding with MCD at six months might be mediated by the propagation of habits as an expression of social patterning, but this requires future in-depth studies. Not surprisingly, a dose-response relationship was found where the number of infants with a high BMI was higher if they consumed more MCD.

It is important to note that a high BMI at 12 or 18 months of age does not necessarily predict obesity at pre-school age. In addition, other factors both nutritive and non-nutritive, which may be involved and of which we have neither knowledge nor understanding and which may be relevant, need to be taken into consideration.

The growth of a child is a sensitive measurement of both physical and psychosocial health, and is often regarded as a health indicator (Tanner, 1990). Considering that parents are in favour of greater infant weight and regard infant growth in the higher percentile as an indicator of good health (Study I), which is in agreement with other studies (Aarts, 2001; Maynard, 2003; Laraway, 2010; Redsell, 2010), they will probably not regard rapid infant weight gain as detrimental. Quite the reverse, in fact; it can be perceived as a signal of good enough parenting (Study I). This aspect has important implications for the optimal timing of interventions to improve child health in a cost-effective manner.

5.4 Parental leave and child health

Numerous studies have shown a strong correlation between mothers' need to return to work and/or studying and shorter breast-feeding duration (Lewallen, 2006; Kools, 2006; Javanparast, 2011). The high breastfeeding rates in Sweden are often attributed to the generous parental leave (Galtry, 2003). Parental leave has been shown to have a favourable and possibly cost-effective impact on child health, as well as a positive impact on breastfeeding (Ruhm, 2000; Deutsch, 2001; Baker, 2008). The parental leave entitlement in Sweden gives parents the right to a total of 480 days' leave until the child reaches the age of eight years (SOU, 2005:73). Lately, there has been a strong desire for fathers to be more involved in parenting and many parents have chosen to split the parental leave during infancy and sometimes as early as during the first four-five months. This "gender-equality oriented policy model" is the result of a politically and socially strong desire for fathers to be more involved (Gislason, 2001; Lammi-Taskula, 2011). Swedish mothers almost always take parental leave, but their willingness to share it with the father increases with their level of education (RFV, 2003). We speculate that early equally shared parental leave, *i.e.* when the child is three-four months, may mean that some mothers chooses to reduce or cease breastfeeding altogether. This is an aspect that has not been the subject of any research to date.

Traditionally, mothers have been targeted with infant feeding information in order to influence them to make the right choice. In analogy to the above, the aspect of food and feeding should henceforth be regarded as a parental joint venture and not only as a maternal responsibility. Both parents should therefore be offered food and feeding information and support.

5.5 Household purchasing power

Low household purchasing power was significantly associated with not breastfeeding at four months of age. Low parental age and educational attainment were also shown to be associated with low breastfeeding rates (Studies II, IV). For most families low household purchasing power is a potent stressor. Low income, the inability to meet expenses and/or a lack of cash reserves is for many parents the constant worry which may mean a lower threshold to tackle real-life situation such as an infant that cries intensely.

Even though Sweden ranks among the top countries in the Organisation of Economic Co-operation and Development (OECD) Better Life Index with a high standard of living, well-educated population, well-developed parental insurance and parental leave and child health service that are free of charge, there are substantial socio-economic differences with child health inequality as a consequence (OECD, 2011; SNIPH, 2011).

The relationship between food, nutrition, society, economy and culture is highly relevant for population health and welfare. As described earlier there is a social gradient in health and it is obvious during childhood with visible consequences in adulthood. With the aim of maximizing health outcomes and ameliorating health inequalities universal action is needed, but on a scale and intensity that is proportionate to the level of disadvantage *i.e.* proportionate universalism (Marmot, 2008). The geomapping method (Study IV) provided us with an overview of vulnerable geographical areas, which may be relevant to consider in conjunction with targeted actions.

5.6 Child health services

The CHC nurses are particularly well placed to promote breastfeeding and healthy food choices in early childhood, primarily because they see almost all infants and parents on a regular basis (MFR, 1999). As described earlier the parents stated that they received breastfeeding support and were satisfied (Study II). For most mothers, the infant feeding goal is a contented infant, but they perceive that the goal of the health professional focuses more heavily on the continuation of breastfeeding (Hoddinott, 2000). This is consistent with two Swedish studies describing the maternal perception of inadequate support and understanding of their anxiety and that no heed had been taken of their concerns and worries regarding feeding issues (Baggens, 2001; Bramhagen, 2006). The CHC reaches almost all parents with the universal

medical programme, but there is a need for indicated support, which must be based on individual assessments of the needs of each family (Wallby, 2012).

'All that has been written on the choice of nurses,
and the nourishment of children,
is hardly anything more than a collection of prejudices.'
N. BROUZET (1755) (Wickes, 1952)

5.7 Parental adherence and compliance

A recurring feature in this thesis, despite the fact that it was not the object, is parental non-compliance with standard infant feeding recommendations, *e.g.* breastfeeding, exclusive breastfeeding, infant formula and bottle-feeding. Most parents are well aware of the benefits of breastfeeding and what constitutes healthy infant foods and parental non-compliance is therefore a well-thought out option (Heinig, 2006; Kelly, 2006). One major obstacle could be a genuine gap between parental knowledge, beliefs and, by extension, parental behaviour as to what a healthy diet, snacks and in-between meals constitute, and what the consequences of this may have, *i.e.* the level of parental education and literacy probably reflects health knowledge and behaviour (Dielman, 1982; Desai, 1998; Coveney, 2004; Clark, 2007; Gillis, 2009). In comparison with parents from higher socioeconomic groups, parents from the lower socioeconomic groups benefited less from professional postnatal support (Renfrew, 1995). Low-income parents who are stretched by a lack of money may have poor coping strategies and less energy to persevere with breastfeeding, tooth-brushing or wrestling with children to apply safety belts (Case, 2002; Kelly, 2006). As a result, current interventions may be less effective in less well-educated groups, whereas general information may be better understood and applied by well-educated parents.

5.8 Knowledge gaps and research needs

Infancy is nutritionally a vulnerable time and it is therefore of the outmost importance that bottle-feeding parents are also provided with adequate support and unprejudiced information about infant formula, its preparation and an adequate amount of formula in relation to infant growth. As described earlier, there are very few studies describing bottle-feeding except as a risk for not breastfeeding, and there is an unmet parental need for additional knowledge about bottle-feeding and nursing.

It is vital to discuss and intervene in some of the less healthy feeding routines, such as nighttime soothing with a bottle (study III) and the risk of overdosing of formula powder (Lakshman, 2009). Equally important in this respect is the fact that a great deal of emphasis has been placed on the first six months of life and then first and foremost on breastfeeding, but there are very few feeding studies from six months to 24 months. Improving people's understanding and management of the early feeding choices may have an impact on growth on a short- and long-term basis and the way healthy eating can be promoted in some vulnerable groups.

5.9 Implications for health policy and prevention

Early breastfeeding cessation depends on many factors and some may be modifiable, *e.g.* breastfeeding difficulties, but the timing, as mentioned earlier, is crucial. Neighbourhood purchasing power provided a spatial determinant of not breastfeeding at four months of age, which may be relevant to consider when designing targeted actions in vulnerable areas. Studies have shown that interventions tailored to suit particular socioeconomic or cultural groups with multifaceted interventions appear to be the most effective (Dyson, 2995; Britton, 2007), but this calls for understanding and knowledge of the vulnerable population which in turn requires appropriate data gathered over time *e.g.* geographical information data (Study IV). Lastly, achievable breastfeeding goals are desirable. The idealistic policy goals such as exclusive breastfeeding until six months of age as an individual goal for women, can be regarded as unattainable and therefore unnecessary and perhaps even detrimental for some.

The fragmentation of research agendas and policies on paediatric nutrition is most unfortunate, unlike the WHO, where the different policies have been integrated into one overall feeding policy (WHO, 2008). Understanding paediatric nutrition and developing nutritive intervention to inspire healthy child-feeding practices requires a deep understanding of concepts such as reciprocity and nurture (van Esterik, 2002).

There is a paramount need for universities to broaden education for health care staff, *e.g.* paediatricians, dieticians and nurses. It should be permeated with updated scientific evidence, taking account of the aspect of care, which is a relatively new aspect within the field of nutrition (Engle, 1997; Smale, 2006). Health professionals need to be more knowledgeable not only about breastfeeding, but also about bottle-feeding and infant formula and weaning

practices. Future nutritional counselling must be in tune with our knowledge and understanding of the growth charts.

The three disciplines, *child health*, *paediatric nutrition* and *infancy growth,* are all independent entities, but they interact with one another in an ongoing, dynamic process, sometimes in two-way and sometimes in three-way communication. Infant feeding has an effect on growth and infant size and growth has an effect on feeding. Parental influence, *i.e.* genetically on infant size and growth, attitudinally and behaviourally on the kind of feeding mode they choose and lastly on the parental beliefs and relating to child health influences, will have an effect on all these aspects and will have an impact on the ongoing process (Figure 1). We are now at the crossroads either the parental perspective is taken into account and help and support are offered on all infant food and feeding aspects, or health care personnel shall persist in propagating non-credible advice and recommendations and the parents will choose their own paths.

To sum it up, parental views and considerations on the concept of child health lead to parental choices in everyday life, influencing nutrition and care of the child. Cessation of breastfeeding depends on factors that may be modified by the child health services. Nutritional patterns during the first year of life may lead to overweight later in childhood.

"The real voyage of discovery consists not in seeking new landscapes, but in having new eyes". Marcel Proust

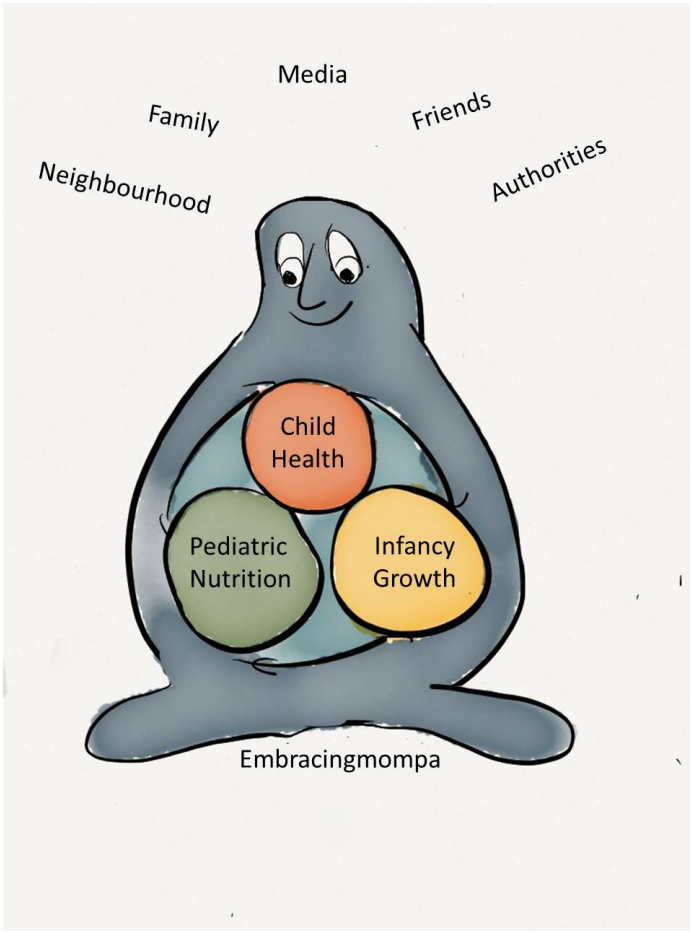

Figure 1. Child health, paediatric nutrition and infancy growth are all independent entities. Each one spinning around its own axis, all interacting with one another in an ongoing process sometimes in a two- and sometimes in a three-way communication, but always under the influence of the mother and the father

6 CONCLUSION

Some parents perceive food and feeding issues as one of the most worrying aspects and a significant indicator of "child health". With the parental desire to have a happy, contented child, there is an element of risk of developing long-term, unhealthy feeding habits. The lack of responsiveness to parental concerns may jeopardise the credibility of healthy infant diet messages.

Almost a third of the mothers reported breastfeeding problems, which is associated with early cessation. Breastfeeding problems can be prevented, but the timing is crucial. In order to promote breastfeeding, the support from the child health centres must be tailored with the maternal perspective in mind. It is essential to ensure that the health-care system provides good breastfeeding support.

Evidence is presented in support of the notion that privileged mothers with high purchasing power are less likely to stop breastfeeding before four months, while, on the other hand, mothers in low-income neighbourhoods stop earlier. The allocation of preventive resources should be reviewed.

This study, which examined the impact of dietary patterns on body mass index (BMI), found that, none of the feeding habits during the first four months had any effect on a high BMI at 12 or 18 months of age. Milk cereal drink use at six months was a risk factor for a high BMI at 12 and 18 months. It was more common among parents with low education to choose milk cereal drink. Only 1.6% were exclusively breastfed at six months.

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The acknowledgements section is most often found as the last pages in a thesis. Furthermore speaking from experience it is probably the part that is most likely to be read. It is here that the PhD candidate is able to demonstrate pent-up gratitude or discontent in a couple of words and so, folks, here it is.

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